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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
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| 10/010,950      | 11/13/2001  | Li-Qun Xia           | 6392/DD/LOW K/JW    | 5694             |

32588 7590 01/30/2003

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EXAMINER

LE, DUNG ANH

ART UNIT

PAPER NUMBER

2818

DATE MAILED: 01/30/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

10/010,950

Applicant(s)

XIA ET AL.

Examiner

DUNG A LE

Art Unit

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 13 November 2001.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-24 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-22 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 4.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_

DETAILED ACTION

***Oath/Declaration***

The oath/declaration filed on 11/13/2001 is acceptable.

***Information Disclosure Statement***

This office acknowledges of the following items from the Applicant:

Information Disclosure Statement (IDS) filed on 11/ 13/ 2001 and made of record as Paper No. 5/21/2002 . The references cited on the PTOL 1449 form have been considered.

***Specification***

The specification has been checked to the extent necessary to determine the presence of all possible minor errors. However, the applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.

***Claim Objections***

Claim 1, 8 and 22 are objected to because of the following informalities:

In claim 1, line 8, the term ' a first dielectric layer ' is amended to --a dielectric layer -- in order to particularly define the subject matter which Applicants regard as the invention.

In claims 8 and 22, the term ' a boron-containing ' is amended to -- , a boron-containing -- in order to particularly define the subject matter which Applicants regard as the invention.

### **Claim Rejections**

#### **Set of claims: 1- 12**

#### ***Claim Rejections - 35 USC § 102***

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless --

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

**Claims 1-11 are rejected under 35 USC 102 (b) as being anticipated by Yau et al. (6054379).**

Yau et al. disclose a method for processing a substrate, comprising:

depositing a barrier layer 514 on the substrate 512 (etch stop is cited in column 4, lines 20-25 and figs. 7-8H) by introducing a processing gas comprising an organosilicon compound into a processing chamber (col 4, lines 45-45), wherein the organosilicon

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compound has the formula  $\text{SiH}_a(\text{CH}_3)_b(\text{C}_6\text{H}_5)_c$ , wherein a is 0 to 3, b is 0 to 3, and c is 1 to 4  $\{\text{SiH}_a(\text{CH}_3)_b(\text{C}_2\text{H}_5)_c(\text{C}_6\text{H}_5)_d$ , where  $c=0$  as cited in col 4, line 46 $\}$  and reacting (col 4, lines 55-60) the processing gas to deposit the barrier layer 514, wherein the barrier layer has a dielectric constant less than 4 (col 4, line 60) ; and

depositing a first dielectric layer 510 (col 4, line 24) adjacent the barrier layer 514, wherein the dielectric layer 510 comprises silicon, oxygen, and carbon (col 4, lines 55- 60) and has a dielectric constant of about 3 or less.

{Note: Yau et al. disclose the deposition of low dielectric constant material / low-k dielectric material (dielectric constant  $< 4.0$ ) as cited in column 1, line 46, and it is well-known to one of ordinary skill in the art of making semiconductor devices.}

**Regarding claim 2**, the dielectric layer has a carbon content between about 5 and about 30 atomic percent (col 4, lines 57-59) excluding hydrogen atoms.

**Regarding claim 3**, the dielectric layer is deposited by oxidizing an organosilane or organosiloxane compound in a plasma enhanced chemical vapor deposition technique (col 2, lines 46- 49).

**Regarding claim 4**, the dielectric layer is deposited by reacting trimethylsilane (col 4, line 53) and oxygen (col 3, line 55) in a plasma enhanced chemical vapor deposition technique (col 5, lines 23-25).

**Regarding claim 5**, the dielectric layer is deposited under plasma conditions comprising a high frequency RF power density from about 0.16 W/cm<sup>2</sup> to about 0.48 W/cm<sup>2</sup> (col 14, lines 30- 35).

**Regarding claim 6**, the dielectric layer 510 is deposited prior to depositing the barrier layer 514 (Figs. 8A-8B).

**Regarding claim 7**, the organosilicon compound comprises diphenylmethylsilane, dimethylphenylsilane, or combinations thereof (where c=0 as cited in col 4, lines 45-47).

**Regarding claim 8**, the processing gas further includes a dopant component selected from the group of an oxygen-containing compound, a nitrogen-containing compound a boron-containing compound, a phosphorus-containing compound, and combinations thereof. (col 4, lines 54-53).

**Regarding claim 9**, the oxygen-containing compound is selected from the group of oxygen, ozone, a siloxane, and combinations thereof (col 4, lines 54-53).

**Regarding claim 10**, the nitrogen-containing compound is selected from the group of nitrogen gas, ammonia, a silazane, and combinations thereof (col 4, lines 54-53).

**Regarding claim 11**, the processing gas further comprises an inert gas selected from the group of argon, helium, neon, xenon, or krypton, and combinations thereof (col 10, lines 61-64).

**Claim Rejections - 35 USC § 103**

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

**Claim 12 is rejected under 35 U.S.C. 103 (a) as being unpatentable over Yau et al. in view of the remark.**

Yau et al. disclose claimed invention as applied to claim 1 except for the barrier layer comprises less than about 15 atomic percent of oxygen as cited in instant claim.

It would have been obvious to one having ordinary skill in the art making semiconductor device to determine the workable or optimal value for the barrier layer comprises less than about 15 atomic percent of oxygen as cited in instant claim through routine experimentation and optimization to optimal device performance.

**Set of claims: 13-22**

**Claims 13- 21 are rejected under 35 USC 102 (b) as being anticipated by Yau et al. (6054379).**

Yau et al. disclose a method for processing a substrate, comprising:

depositing a barrier layer 514 on the substrate 512 (etch stop is cited in column 4, lines 20-25 and figs. 7-8H) by introducing a processing gas comprising an organosilicon compound into a processing chamber (col 4, lines 45-45), wherein the organosilicon compound has the formula  $\text{SiH}_a(\text{CH}_3)_b(\text{C}_6\text{H}_5)_c$ , wherein a is 0 to 3, b is 0 to 3, and c is 1 to 4  $\{(\text{SiH}_a(\text{CH}_3)_b(\text{C}_2\text{H}_5)_c(\text{C}_6\text{H}_5)_d$ , where  $c=0$  as cited in col 4, line 46} and reacting (col 4, lines 55-60) the processing gas to deposit the barrier layer 514, wherein the barrier layer has a dielectric constant less than 4 (col 4, line 60) ; and

depositing a dielectric layer 510 (col 4, line 24) adjacent the barrier layer 514, wherein the dielectric layer 510 comprises silicon, oxygen, and carbon (col 4, lines 55-60) and has a dielectric constant less than 4.

{Note: Yau et al. disclose the deposition of the low dielectric constant material / low-k dielectric material (dielectric constant  $< 4.0$ ) as cited in column 1, line 46, and it is well-known to one of ordinary skill in the art of making semiconductor devices.}

**Regarding claim 14**, the dielectric layer has a carbon content between about 5 and about 30 atomic percent (col 4, lines 57-59) excluding hydrogen atoms.

**Regarding claim 15**, the dielectric layer is deposited by oxidizing an organosilane or organosiloxane compound in a plasma enhanced chemical vapor deposition technique (col 2, lines 46- 49).



**Regarding claim 16**, the dielectric layer is deposited by reacting trimethylsilane (col 4, line 53) and oxygen (col 3, line 55) in a plasma enhanced chemical vapor deposition technique (col 5, lines 23-25).

**Regarding claim 17**, the dielectric layer is deposited under plasma conditions comprising a high frequency RF power density from about 0.16 W/cm<sup>2</sup> to about 0.48 W/cm<sup>2</sup> (col 14, lines 30- 35).

**Regarding claim 18**, the dielectric layer 510 is deposited prior to depositing the barrier layer 514 (Figs. 8A-8B).

**Regarding claim 19**, the organosilicon compound comprises diphenylmethylsilane, dimethylphenylsilane, or combinations thereof (where c=0 as cited in col 4, lines 45-47).

**Regarding claim 20**, reacting the organosilicon compound comprises reacting the organosilicon compound with an oxygen-containing compound selected from the group of oxygen, ozone, a siloxane, and combinations thereof (col 4, lines 54-58)

**Regarding claim 21**, the oxygen-containing compound is selected from the group of oxygen, ozone, a siloxane, and combinations thereof (col 4, lines 54-53).

**Regarding claim 22**, the processing gas further includes a dopant component selected from the group of an oxygen-containing compound, a nitrogen-containing compound, a boron-containing compound, a phosphorus-containing compound, and combinations thereof. (col 4, lines 54-53).

**Regarding claim 23**, the nitrogen-containing compound is selected from the group of nitrogen gas, ammonia, a silazane, and combinations thereof (col 4, lines 54-53).

**Regarding claim 24**, the processing gas further comprises an inert gas selected from the group of argon, helium, neon, xenon, or krypton, and combinations thereof (col 10, lines 61-64).

**Claim 25 is rejected under 35 U.S.C. 103 (a) as being unpatentable over Yau et al. in view of the remark.**

Yau et al. disclose claimed invention as applied to claim 1 except for the barrier layer comprises less than about 15 atomic percent of oxygen as cited in instant claim.

It would have been obvious to one having ordinary skill in the art making semiconductor device to determine the workable or optimal value for the barrier layer comprises less than about 15 atomic percent of oxygen as cited in instant claim through routine experimentation and optimization to optimal device performance.

When responding to the office action, Applicants' are advice to provide the examiner with the line numbers and page numbers in the application and/or references cited to assist the examiner to locate the appropriate paragraphs.

A shortened statutory period for response to this action is set to expire 3 (three) months and 0 (zero) day from the day of this letter. Failure to respond within the period for response will cause the application to become abandoned (see M.P.E.P 710.02(b)).

***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dung A. Le whose telephone number is 703-306-5797. The examiner can normally be reached on Monday-Friday 8:00am-5:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David Nelms can be reached on 703-308-4910. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-7722 for regular communications and (703) 308-7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

Dung A. Le



Date: 9-03-11

Dung A. Le



Examiner

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